2661

Amendment

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT:	GHOSH ET AL.	EXAMINER:	
SERIAL NO.:	09/742,905	GROUP:	2661
FILED:	12/20/2000	CASE NO.:	CE08950R
TITLED:	MULTI CHANNEL STOP AND WAIT ARQ COMMUNICATION METHOD AND APPARATUS		

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Preliminary Amendment

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Assistant Commissioner for Patents
Washington, D.C. 20231

on 3/15/01 (Date)

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Signature

Box Non-Fee Amendment
Assistant Commissioner for Patents and Trademarks
Washington DC, 20231

Sir:

Prior to examination of the above-captioned application, please enter the following amendment:

AO

In the Specification

Please insert the following paragraphs after line 35 on page 1.

A general description of prior-art ARQ is given with reference to FIG. 1. In a communication system 100, a source user 101 transmits a first data packet 111 over a first time frame 121 having a finite time period 131. Source user 101 may be a base station in communication system 100. Source user 101 may be in communication with several destination users such as destination users 151-54. Such communication may by way of a forward link 180 received by a group of targeted destination users, and a corresponding reverse links 181-84. Such destination users may be mobile stations in communication system 100. Communication system 100 may be operating according to any of the known communication standards such as GSM, IS-95A, B and C, and Wideband Code Division Multiple Access (WCDMA) of the Third Generation Partnership Program. Source user 101 transmits a second data packet 112 over a second time frame 122, where second time frame 122 is immediately subsequent to first time frame 121 in a sequence of time frames 190. Sequence of time frames 190 is transmitted via forward link 180.

When a destination user receives a data packet and decodes the packet satisfactorily without error according to a standard, the destination user transmits back on a control channel via a reverse link an acknowledgment message to the source user acknowledging acceptable reception of the data packets. In this case, if first data packet 111 is targeted for destination user 151, destination user 151 transmits an acknowledgement via reverse link 181 to source user 101 acknowledging acceptable reception of the first data packet 111.

Source user 101 repeats transmission of first and second data packets 111 and 112 in a sequence of first and second time frames 121 and 122 until detecting the acknowledgment of acceptable reception of either data packet 111 or 112. After transmission of data packets 111, source user 101 expects detection of an acknowledgment of acceptable reception of data packet 111, and similarly after transmission of data packet 112, source user 101 expects detection of an acknowledgment of acceptable reception of data packet 112. If acknowledgement associated with data packet 111 has not arrived at source user 101 before transmitting a time frame 123, transmission of data packet 111 is repeated in time frame 123 which is immediately subsequent to time frame 112. Similarly, if acknowledgement associated data packets 112 has not arrived before transmitting a time frame 124, transmission of data packet 112 is

repeated in time frame 124. The transmission sequence of data packets 111 and 112 is repeated until arrival of an acknowledgement associated with either data packets 111 or 112. In all cases above describing a repeat of data packet, it is possible to substitute an associated packet constructed entirely of parity information or an alternate combination of information and parity. This substitution represents an alternate form of Hybrid ARQ known as Incremental Redundancy.

After the acknowledgment of acceptable reception to either data packet 111 or 112, source user terminates transmission of its associated data packet. Source user 101 transmits a third data packet in substitute of the terminated data packet in the sequence of the first and second time frames.

The sequence of the first and second time frames may be consecutively odd and even numbered time frames in numbered time frames such as time frame sequence 190 in a time division multiple access communication system. If time frame 121 is numbered as "n", an even number time frame, time frame 122 is then an odd numbered time frame, time frame "n+1". Similarly time frame 123, time frame "n+2", is an even numbered time frame, and time frame 124, time frame "n+3", an odd numbered time frame, and so on. The first time frame may be referred to as an odd numbered channel and second time frames as an even numbered channel immediately subsequent to the odd numbered channel in a time division multiple access communication system.

If data packet 111 was transmitted on an even numbered time frame and data packet 112 on an odd numbered time frame of sequence of time frames 190, transmission of data packets 111 and 112 on even and odd numbered time frames continues until an acknowledgement associated with either data packet 111 or 112 is detected at source user 101. For example, if the acknowledgement is associated with data packet 112, a third data packet is selected for transmission in substitute of the data packet 112. As such, the third data packet is transmitted on the odd time frames, and the data packet 111 on the even time frames of sequence of time frames 190.

The first and second data packets may be transmitted for a same destination user or a first and second destination users. For example, in down link 180, data packets 111 and 112 may be destined for a single destination user such as any of the destination users 151-54. In another situation, the data packets 111 and 112 may be destined for respectively destination users 151 and 152, for example. Similarly, any substituted data packet may be for the same or different destination users.

In case the downlink received by a destination user is in poor condition, an acknowledgement may not be transmitted from the destination user for some time. During this time, the data packets destined for such a destination user may be repeated

many times in the first and second time frames. To avoid unnecessary usage of the communication resources in the down link 180, source user 101 limits transmission of the data packet to a predetermined number of repetitions.

Source user 101, along with other blocks such as an encoder (not shown), may include a queue buffer 102 for buffering data packets for transmission. A channel sequencer 103 retrieves the first and second data packets from queue buffer 102 and aligns the first and second data packets in sequence to be received by a transmitter 104 for transmission from an antenna 105 from source user 101. Queue buffer 102 may buffer data packets according to a transmission priority of the first and second data packets. In case of transmitting a third data packet, the first, second and third data packets are queued in buffer for transmission from the source user according to a transmission priority. The third data packet may be selected from a plurality of data packets in queue buffer 102 based on a transmission priority when being substituted for either the first or the second data packet in the sequence of the first and second (i.e. even and odd or odd and even) time frames.

To perform hybrid ARQ portion, the destination users combines correspondingly soft copies of the repeated transmission of data packets for decoding the data in the data packet. Once a data packet satisfactorily is decoded via soft combining, the destination user generates and transmits an acknowledgment of acceptable reception of data packet. As such, when the first and second data packets are destined for the same destination user as a mobile station, the mobile station is required to have a memory buffer for storing the first and second data packets upon arrival. In case of soft combining, soft copies of the first and second data packets may need to be stored. This is a substantial reduction in memory requirement in a mobile station operating in a communication system relative to alternative ARQ schemes according to various aspects of the invention.

In case the acknowledgment of acceptable repetition of a data packet can not arrive within a time frame, a time in units of a finite time period is determined when at a source user a feedback acknowledgment can arrive acknowledging acceptable reception of a data packet at a destination user. The finite time period may equal to duration of time frame. A source user transmits multiple data packets in a sequence of multiple time frames equal to the determined units of time frames. While waiting for detecting an acknowledgment of acceptable reception of data packet associated with either one of the multiple data packets, transmission of the multiple of data packets in the sequence of multiple time frames is repeated. The time may be approximately an earliest time when at the source user the feedback acknowledgment can arrive acknowledging acceptable reception of the data packet at a destination user.

After detecting an acknowledgement, transmission of either one of the multiple data packets associated with the acknowledgement in the sequence of multiple time frames is terminated. A new data packet is transmitted in substitute of the terminated data packet in the sequence of the multiple time frames. The multiple data packets may be transmitted for a same destination user, or a multiple destination users. The number of retransmission of the multiple data packets may be limited according to a predetermined number of repetitions to avoid unnecessary usage of the communication resources in case of a poor communication between the source user and one of the destination users.

The multiple time frames may be consecutively numbered time frames in a numbered time frames in a time division multiple access communication system. At the destination users, soft copies of the repeated transmission of data packets correspondingly are combined for generating and transmitting a corresponding acknowledgment of acceptable reception of data packet.

When used in a Code Division Multiple Access (CDMA) system, it is possible to send multiple packets in the even period and multiple packets in the odd period. When anyone of the multiple packets is acknowledged it may be replaced independently of all the other packets in the manner described previously. Various aspects of the invention may be implemented by way of software or hardware implementations. Use of such methods is well known in the art. The source user may be a base station and the destination user may be mobile stations in a cellular communication system. The source user and destination user may also employ an encoding and decoding apparatus known in the art.

Please delete the text starting with "According" on page 3, line 12 and continuing through page 6, line 33.

On page 2, line 31, please change "FIG. 1 depicts a communication system employing various aspects of the invention." to "FIG. 1 depicts a communication system employing prior-art ARQ."

Remarks

The original application was filed with FIG. 1 missing, and the other figures mislabeled. After reviewing the application it was decided that FIG. 1 was a simple description of prior-art ARQ systems. Therefore, the Applicants have elected to remove all reference from FIG. 1 from the Detailed Description of the preferred Embodiment, and modify the Background of the Invention to describe prior-art ARQ. Since no new matter is being added to the detailed description, and only that which is known is being added, the Examiner should have no issues with the changes made.

The Applicants are also submitting marked-up drawings showing the changes made to the figures along with a supplemental application showing the changes made.

Respectfully Submitted,
GHOSH ET AL.

by:________________

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